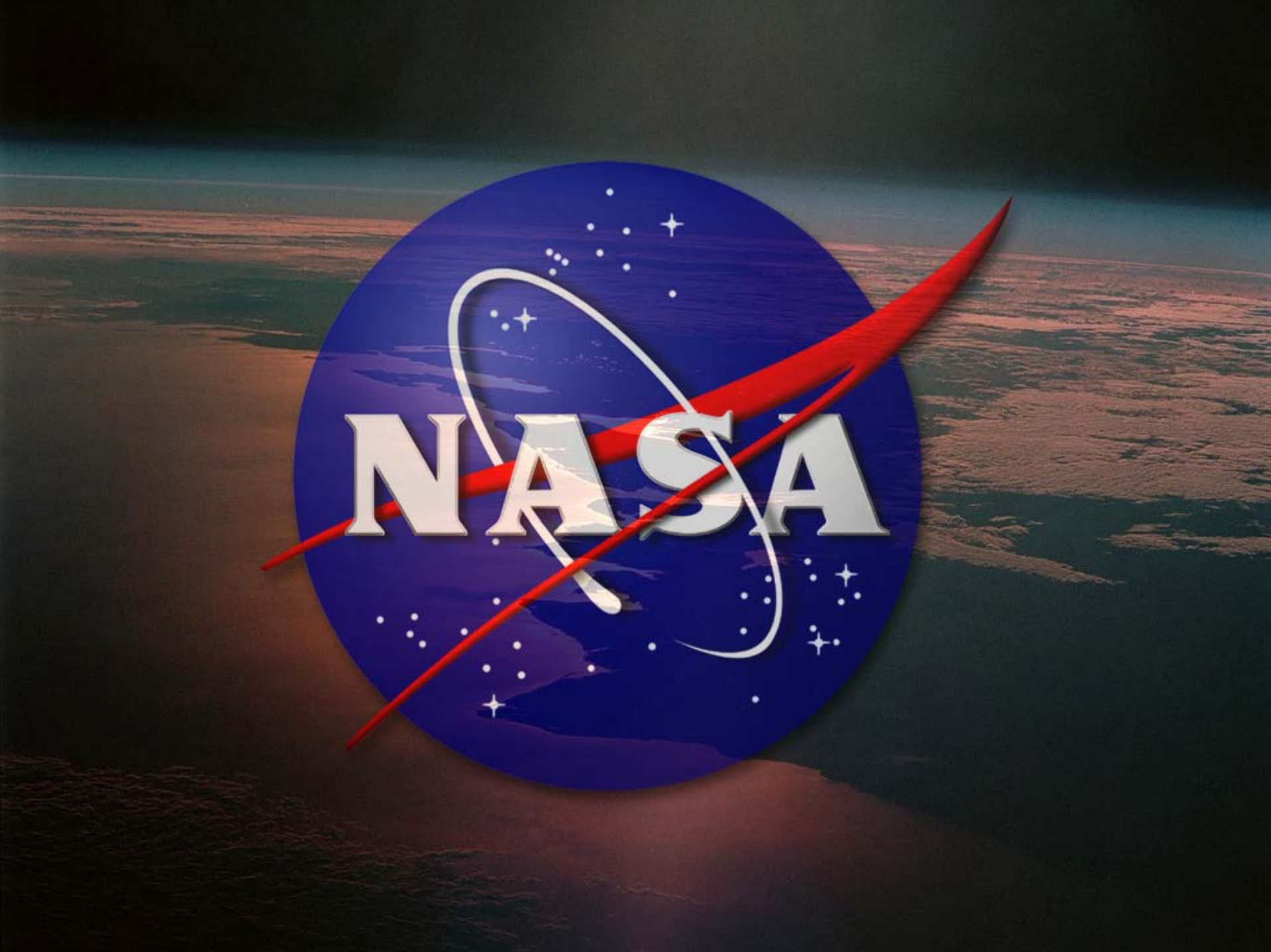
NASA

What's the Mission?

To recover critical components of the Space Shuttle Columbia in order to provide insight into the cause of the mishap and prepare for return to flight

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Why helicopters?

Effective platform for rapid coverage of debris field with fewer personnel

Define the boundaries of the ground search effort (nothing is something)

1250 items found to date, 12% significant left wing items found by helo

Significant items: tile, RCC, ET Sep camera, ops recorders

The stated mission is neither time critical nor deemed essential to the immediate safety of the local population like those encountered fighting wildland fires

Therefore, flight within the avoid range of the height/velocity curve over trees and non-level terrain must be mitigated on a mission-by-mission basis.

The intent is to search areas “clear” of trees that would prevent a safe landing (a safe landing is any landing from which all crewmembers can walk away) in the event of any aircraft emergency requiring an immediate landing

Risk analysis conducted 3 & 4 April, 2003
Utilizing Chapter 3 “Operational Planning” of the Interagency Helicopter Operations Guide (IHOG).

Board members:

Wayne Fairley – (FEMA) Facilitator
Tim Pfahler – (USFS R-1)
J.P. Greene – (FL DOF)
Dennis Brown – (USFS)
Boo Walker – (Texas Forest Service) Air Operations Manager
Joe Deen – (NASA/KSC) Flight Operations Lufkin Air Chief
Joe Wade – (NASA/KSC) Flight Personnel
Rocky Smith – (NASA/JSC Aircraft Operations Division)
Butch Wilmore – (NASA/JSC Astronaut Office) NASA Air Ops

Chart 3-2:
Risk Assessment
Matrix

Effect			Hazard Probability				
			Frequent	Likely	Occasionally	Seldom	Unlikely
			A	B	C	D	E
	Catastrophic	I	Extreme		High		Medium
	Critical	II	High	High		Medium	
	Moderate	III	High	Medium		Low	
	Negligible	IV	High				

-Catastrophic: Death or serious injury; system/equipment loss (aircraft or ground accident)

- Critical: Serious injury; damage to equipment

- Moderate: Mission can be accomplished, though there may be adverse effects on mission efficiency (extra cost, delays, etc.)

- Negligible: No effect on mission accomplishment

-Frequent: May be continuous or often encountered during each mission.

- Likely: May be encountered several times during the course of many missions.

- Occasional: May be encountered sporadically during the course of many missions.

- Seldom: May be encountered infrequently, but chances are remote.

- Unlikely: May be encountered only rarely; chances are possible, but improbable.

Chart 3-2:
Risk Assessment
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Effect			Hazard Probability				
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	Critical	II	High	(3)(4) High (5)		Medium	
	Moderate	III	High	(7) Medium		Low	
	Negligible	IV	High				

These ratings based on unmitigated hazards

Event	Effect	Probability	Risk Level
1) Low Speed / Low altitude / Over Trees	Catastrophic	Frequent	Extreme
2) Aircraft Operation w/ Doors Removed	Catastrophic	Occasional	High
3) Unimproved Landing Zone	Critical	Likely	High
4) Crew Fatigue	Critical	Likely	High
5) Blade Strike	Occasional	Critical	High
6) Engine Failure	Catastrophic	Unlikely	Medium
7) Weather	Moderate	Likely	Medium

Composite Risk Level – ”HIGH”

“All aircraft operations will comply with the guidance dictated in their specific aircraft operations manual”

Low Speed / Low Altitude / Over Trees

The intent is to search "clear" areas that would allow safe landing (a safe landing is any landing from which all crewmembers can walk away in the event of any aircraft emergency requiring an immediate landing). DON'T SEARCH OVER TREES.

No "search" operations are to be conducted over areas where the trees (canopy) or terrain prevents the ability of the observers to visually detect objects 12"x12" in size or larger with a 75% probability or higher

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A high and mid-level recon will be completed prior to commencing low-level search operations.

A 20' minimum over all obstacles will be adhered to (considered best altitude to keep helo above the majority of potential obstacles while still enabling crew survivability upon landing in case of mechanical failure).

If flight operations are conducted over areas where in the advent of an engine failure, a safe autorotation / emergency landing cannot be executed, it is incumbent on the pilot and crew to assess and mitigate the risk prior to the operations in that environment.

Personal Protective Equipment (PPE) will be worn at all times.

In order to reduce exposure, the total crew complement will be limited to 4 personnel. As such, the helicopter performance capabilities must allow safe operations with 4 personnel.

Low Speed / Low Altitude / Over Trees

Transit to and from Search Grids

Transit from the helibase to search grids and between search grids & refueling locations will be accomplished at 1500’ MSL.

Transit from search grids and refueling locations to the helibase will be accomplished at 1200’ MSL.

Transit between searchable (clear) areas in a search grid

Transitions within grids will be accomplished while maintaining altitude and airspeed commensurate with accomplishing a survivable crash landing in the event of mechanical malfunction.

There will be a 1000’ MSL maximum altitude ceiling during searches.

Aircraft Operation w/ Doors Removed

FOD: Crews must be thoroughly briefed to ensure FOD control in the event the doors are removed.

Doors may be removed to improve mission effectiveness.

Seat Belts & Harnesses

The mission shall not necessitate the utilization of harnesses which allow crewmembers to hang beyond the helicopter airframe.

No part of any individual or any item should be outside the airframe of the helicopter during flight.

Seat belt restraint is for crash survivability. Tape or mod of any kind **NOT Permitted**. The belt should never be relied on to keep personnel in the aircraft under normal flight operations. As such, if accidental actuation of the seat belt actuator occurs, the individual should be seated firmly in their seat and belt actuation should be of no effect. Bottom line … the seat belt should not be relied on to keep personnel in the helicopter under normal operations (i.e. do not lean out against the belt and rely on it to keep you in the helicopter).

Unimproved Landing Areas

The helicopter will land to retrieve debris only in safe landing areas as determined by the pilot and the helicopter manager. All landing zones will be "In Ground Effect" with a minimum 15'x15' solid, level touchdown pad with minimum 75' safety circle clearance for rotor system. This determination will be in accordance with established rules for unimproved helispots.

If a determination is made to land, the pilot will state their intentions to the crewmembers on board and to the air tactical group supervisor for the assigned zone. All crewmembers will cease search operations and assist with the safe landing of the aircraft. The cockpit will become a sterile environment using all crew to communicate hazards to the pilot.

If it is determined that an item cannot be retrieved safely it will be marked on the map and the coordinates will be written on the data sheet for retrieval by ground forces.

Crew Endurance During Search Operations

Flight at the required search altitudes for extended periods can be very fatiguing. As such, the following controls will be implemented to ensure the risk of detrimental fatigue is mitigated:

The Flight in the low-level search environment will be restricted to 1.5 hours between refueling cycles (not to include time transiting to and from grids).

Total search time will not exceed 4.5 hours per day.

Total flight time will not exceed 6.5 hours per day.

Blade Strike

Ensure observers are made aware of hazards associated with blade strikes, loss of situational awareness/focus during the Operational and Safety Procedures briefing.

Proper Crew Resource Management (CRM) necessitates warning all crewmembers of potential hazards as soon as they are identified.

The daily safety briefing will address the high potential of blade strikes.

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20 feet, both vertically and horizontally, from all obstacles will be maintained at all times during mission flight operations.

A sterile cockpit must be observed during search and takeoff & landing operations.

We will use only “Type 3” helicopters since the rotor diameter is smaller which is considered a mitigating factor for blade strike potential.

Weather

The mitigation measures previously in place are acceptable with the exception of …

Remove the “Icing” guidance for the Air-Attack aircraft from the Aircraft Operations Minimums as FAR guidance is sufficient.

Follow the aircraft VFR minimums sheet published per the aircraft operations plan.

Feedback

- A feedback capability from each end user (Pilot, Manager, and Searcher) will be Implemented and Stressed.

- The helibase manager will gather "Risk Mitigating" feedback from each helicopter flight crew at each helibase on a daily basis.

- The helibase manager will submit a daily written report of all issues brought to their attention.

- This form must be signed off daily by the Operations Aviation Safety Officer, Air Operations Branch Director, Aviation Coordinator, Texas Forest Service Air Boss (Boo Walker) and the NASA Air Operations Officer.

- Each identified issue must be addressed in a timely manner (1 day if possible) and feedback given to the initiator.

- If issues, which effect overall operations are identified, prompt attention will be given to alleviate the problem.

-The identical process is in place for fixed wing operations except it will flow through the Air Operations Branch Director.

Crewmember Roles

Pilot Expectations

- Pilots are to devote 100% of their efforts to the safe operation of the helicopter they are not to search for Shuttle debris (Single Pilot mindset).

Helicopter Manager (HCWN) Expectations

- The primary duties of the HCWN are prescribed in chapter 2 of the IHOG. To summarize, he is to aid the pilot in clearing for flight hazards & coordinating search within the assigned grid. When primary duties allow, the HCWN may aid in the search for shuttle debris.

Helicopter Search Crewmember (NASA and/or Interagency Personnel) Expectations

- Primary search aircrew
- Search methods and helicopter safety must be thoroughly understood before flight operations commence.
- IMMEDIATELY call out any suspected hazard (wire, tree, livestock, wildlife, etc.)
- Helicopter safety concerns briefing for non-helicopter experienced crewmembers will be conducted
    - Ensure coats that have been removed are secured prior to flight to prohibit it flying out of the cabin into tail rotor.
    - View helicopter flight safety video.

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	Negligible	IV	High				

Event	Effect	Probability	Risk Level
1) Low Level / Low altitude / Over Trees	Catastrophic	Frequent	Extreme
2) Aircraft Operation w/ Doors Removed	Catastrophic	Occasional	High
3) Unimproved Landing Zone	Critical	Likely	High
4) Crew Fatigue	Critical	Likely	High
5) Blade Strike	Occasional	Critical	High
6) Engine Failure	Catastrophic	Unlikely	Medium
7) Weather	Moderate	Likely	Medium

Composite Risk Level – ”HIGH”

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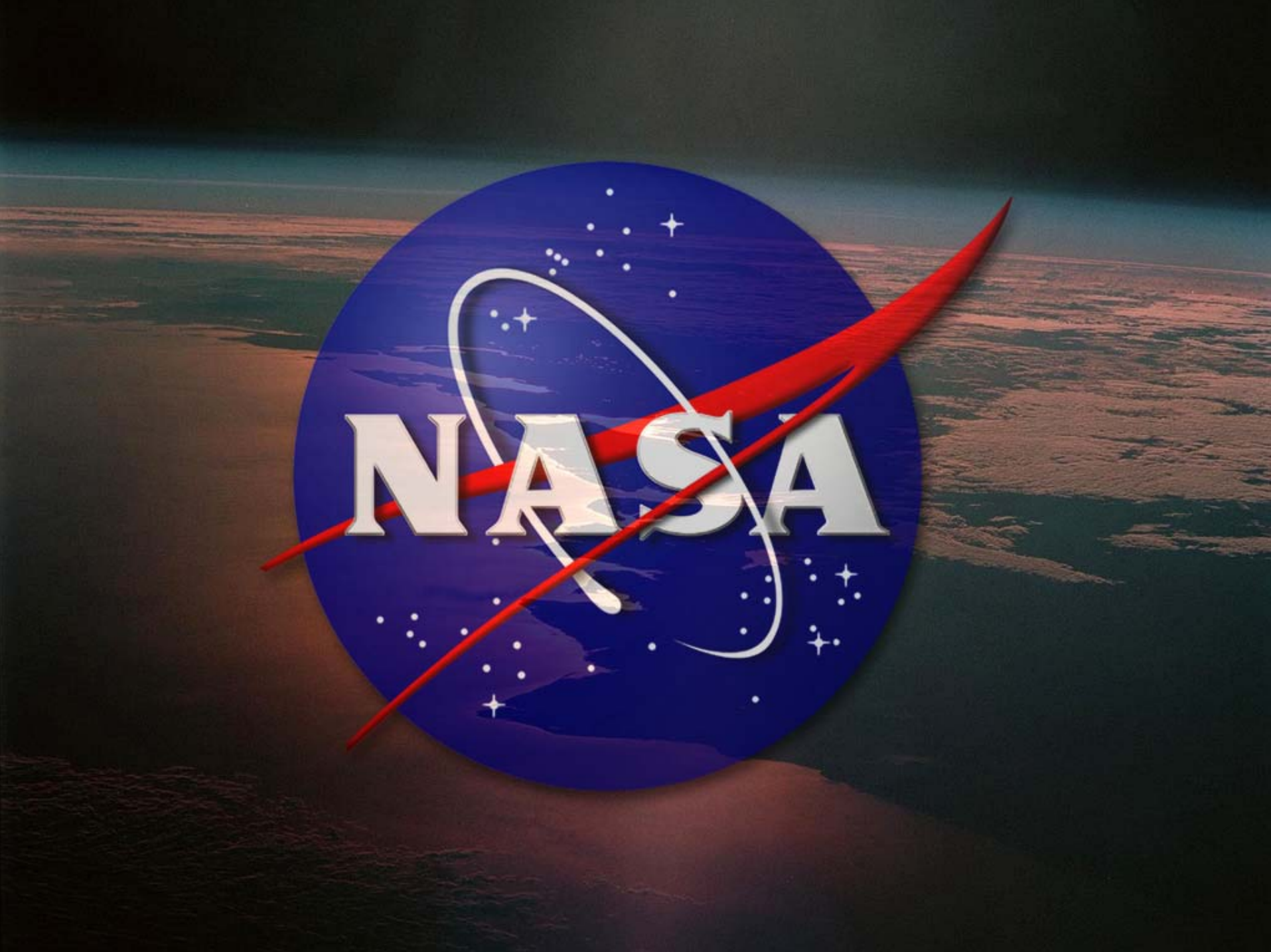
	Moderate	III	High	(1) (7)Medium		Low	
	Negligible	IV	High	(3)			

These ratings determined with prescribed mitigation measures in place

Event	Effect	Probability	Risk Level
1) Low Speed / Low altitude / Over Trees	Moderate	Likely	Medium
2) Aircraft Operation w/ Doors Removed	Catastrophic	Unlikely	Medium
3) Unimproved Landing Zone	Negligible	Likely	Low
4) Crew Fatigue	Critical	Seldom	Medium
5) Blade Strike	Critical	Seldom	Medium
6) Engine Failure	Critical	Unlikely	Low
7) Weather	Moderate	Likely	Medium

Composite Risk Level – ”Medium”


NASA